Texila International Journal of Academic Research
ISSN: 2520-3088
DOI: 10.21522/TIJAR.2014.12.03.Art024

Effect of Learning Cycle Approaches on Students' Achievement in Science in Senior High School

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Abstract

The study examined the effect of learning cycle approaches on academic achievement of students in science. It employed a quasi-experimental non-randomized pre-test, post-test experimental group design. The study used a mixed method approach of both qualitative and quantitative method of data collection and analysis. A detailed lesson plan was prepared to ensure active involvement of students in the learning process. Using the multi-stage sampling procedure, three classes were purposively selected and 120 students were randomly selected to take part in the study. Data was collected through the use of the Science Achievement Test (SAT), interviews, and observations. The data collected was analyzed using the Statistical Package for Service Solutions (version 26.0). The statistical tools employed for the analysis are descriptive statistics (mean and standard deviation) and inferential statistics (t-test and ANOVA). The results showed that:

1. *There was no statistically significant difference in the pre-test scores for the three model class groups. However, there was a statistically significant difference in the post-test scores for the three model groups.*
2. *Also, there was a significant and very large effect of the 3E, 5E, and 7E models on the students taught with the 3E, 5E, and the 7E learning cycle approaches in favour of the 7E.*
3. *There was no significant difference in scores for low- achievers and high achievers taught with the 3E, 5E, and 7E models.*

Keywords: *Achievement, High Achievers, Low Achievers, Learning Cycle Approach, Science.*

Introduction

Learning cycle approach is a pedagogical method that encourages students to engage in a scientific inquiry process through multiple stages, including exploration, concept development, and application. It is a widely utilized pedagogical strategy in science education that emphasizes active engagement, hands-on experiences, and reflection to enhance students' understanding of scientific concepts. This approach is grounded in constructivist learning theory, which posits that students construct knowledge through experiences and interactions with the environment. By incorporating the Learning Cycle model into science instruction, educators aim to promote deeper learning, critical thinking skills, and a more thorough understanding of scientific principles among students.

This study aims to investigate the impact of the learning cycle approach on students' achievement in school.

By guiding students through a series of hands-on investigations, discussions, and reflections, the learning cycle approach aims to foster deep understanding of scientific concepts and principles. Research has shown that the learning cycle approach can improve students' conceptual understanding, problem-solving skills, and critical thinking abilities in science. By actively engaging in the process of inquiry, students are able to make connections between

Received: 11.04.2025 ***Accepted: 29.04.2025*** ***Published on: 31.07.2025***
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their prior knowledge and new information, leading to greater retention and application of content.

Furthermore, the learning cycle approach promotes a student-centered learning environment, where students take ownership of their learning and collaborate with their peers to construct meaning together. This collaborative learning approach has been shown to enhance students' communication skills, teamwork abilities, and overall motivation to learn.

Several studies have investigated the impact of the Learning Cycle approach on students' academic achievement in science. For instance, a study by [23] found that teaching through the Learning Cycle approach improved students' scientific reasoning skills in a science classroom. Similarly, [19] demonstrated that implementing the Learning Cycle model led to enhanced understanding of matter and molecules among middle school students.

In addition, research by [5] evaluated the effectiveness of the BSCS 5E instructional model, which incorporates the Learning Cycle approach, in enhancing students' achievement in science. The findings of their study suggested that the 5E model was effective in improving students' understanding and retention of scientific concepts.

Furthermore, [9] compared the academic outcomes of students in introductory physics courses taught using interactive-engagement methods, including the Learning Cycle approach, with those taught using traditional methods. The study found that students in courses utilizing interactive-engagement methods showed greater improvement in conceptual understanding and problem-solving skills.

Through a review of existing literature and an empirical study, this study aims to examine the impact of the learning cycle approach on students' achievement in science. By analyzing student performance on assessments, surveys, and interviews, this study will provide valuable insights into the effectiveness of the learning cycle approach in enhancing students' learning outcomes in science education. Ultimately, this research seeks to contribute to the ongoing dialogue on effective pedagogical strategies for promoting student achievement in science.

Integrated science is a core subject in the curriculum of the education system in Ghana. The philosophy behind it is production of scientific literate citizens who will be able to use scientific knowledge to solve their everyday problems and also make informed choices and decision at every turn. Consequently, no country can develop without focusing its goal in training citizens who will be scientifically literate, where citizens will not rely on superstitions but will rely on the scientific explanations in their everyday occurrences.

Due to its usefulness in our everyday life, it has been made a core subject in both Junior and Senior high schools in Ghana. This means that each student should the integrated science subject and must get a good pass mark before getting admission to any tertiary institution in the country.

Emphasizing on its importance [3] observed that Science education is needed in Ghana to produce the necessary human resource and skilled labour force to manage our local industries and educational institutions.

Despite it numerous benefits to the individual and the nation at large students still perform poorly in the subject. The chief examiner every year complain about student poorly performing in some of the topics like Magnetism, hydrocarbons, Acid base and Salts, Variation, Hereditary and Evolution, rocks and Mole Concepts [7]. It is therefore necessary to find ways to enhance students’ performance in this subject.

This can be achieved through the provision of effective and appropriate learning experiences to the learner. Teaching over the years has been an effective means of impacting these appropriate learning experiences to the learner. It is therefore the duty of the teacher to select appropriate teaching methods and

materials to facilitate the impacting of these learning experiences to the learner. A desirable change in the learner can best be achieved through the use of appropriate teaching methods [25]. The teacher must also consider the needs of the learner when selecting these methods [9] was of the view that teaching methods work efficiently best when they are aligned with the needs of the learner this is because every learner interpret and responds to issues and experiences in their unique way.

The methods employed by teachers in teaching science have a great impact on the understanding and interest developed by students in the subject [21]. Observed that the use of inappropriate teaching methods contributes to the low participation and performance of students in science. If a teacher does not choose appropriate method in teaching a particular topic, it ends up making students developing poor attitude for the subject even if the teacher has much knowledge in the subject matter. According to [21] 'most commonly used teaching methods at both basic and secondary levels have been found to be lecturing; question and answer; explanations of procedures and note giving". Therefore, there is the need to equip our teachers with both the pedagogy and the content knowledge to enable them teach effectively [13] opined that the method of teaching each subject play a pivotal role in enhancing the efficiency of the practitioners.

Due to its numerous merits in the educational set up, several teaching methods and approaches have been developed to enhance effective teaching of subject matter, content and learning experiences to the learner in a way that will help the learner to easily and meaningfully understand the concepts being taught in the class. These teaching methods were developed through theories of learning as their bases for their philosophical explanation [25].

Science is knowledge obtained by using methods based on systematic observation of the natural environment. In science learning, teachers plan and prepare learning activities so that students do the activities to acquire the knowledge. Many learning models can be used by the teacher in reaching the learning goals. One of these learning models is the learning cycle model. Previous studies have indicated that the application of learning cycle model can facilitates students learning because it helps the student to directly interact with the environment to learn and analyze the phenomena for easily understanding of the concept and achievement of the learning goals.

It also involves students actively in the learning process by offering students the opportunity to explain and express their views, interpret and refine their ideas. Thereby improving on students learning outcomes.

Basically, there are two distinct methods of teaching. These are teacher-centered and student-centered. The teacher-centered method of teaching has its origin from the behavioral learning theory which emphasizes on the provision of appropriate stimuli which will generate the desired outcome in the learner. In this method of teaching students become passive recipient of information from the teacher. Student-centered method however, is built on the constructivist theories which stresses on the active involvement of the learner in the construction of knowledge through the interaction with peers and the learning environment. The influence of constructivist theory has been in existence since the early 1980s and it has had great impact on educational policies and classroom practices.

The Ghanaian Senior High School Integrated Science syllabus advocate for the use of constructivist approaches of teaching which is student-centered in teaching the concept in the syllabus to the learners. This is because the constructivist approach to teaching has proved to promote students understanding of concepts and development of skills to meet the demand of the 2nd century [25].

The Integrated Science teachers unfortunately find themselves in an awkward

situation as to what student-centered method to use since the syllabus did not spell out which student-centered method to use to teach a particular topic in the syllabus.

There are various constructivists teaching approach. The learning cycle has been found to be one of the predominant constructivist teaching approaches which emphasizes on the inquiry-based method of teaching. The inquiry-based method of teaching promotes learning through active questioning, investigation and hand-on activities.

This learning cycle come in several phases. The first version has 3 phases from which different version of the model were generated as four, [5]. It is very necessary for the Integrated Science teacher to know how effective each of this phase is so that they can make informed decisions as to which one they would use. It is in the light of this lack of clarity that this research seeks to explore the effectiveness of each this phase on selected concept in Integrated Science lesson.

The teaching and learning of Integrated Science in most senior high school face a lot of problems. Poor attitude shown by students, poor method of teaching the subject, poor performance of students and lack of materials for teaching the subject [1, 21, 24]. Several studies have indicated that students still learn science by rote learning and therefore affect their understanding of the science concept and consequently affect their interest too because no meaningful learning occurs [9].

Many stakeholders of education have condemned the state of teaching and learning of integrated science at the Basic level and Senior high schools in the country [1, 24, 25]. Many researchers have recommended the inquiry-based learning cycle method as the most effective approach of teaching science that can results in greater achievement in science, better retention of concepts, improved reason ability of students, effective development of process skills in science and improvement of attitudes of students towards science and learning [1, 24, 25].

Despite the recommendations made by several researchers about learning cycle as an effective approach in improving students' achievement and retention of concepts in science, teachers have been found not using it [2].

[25] compared the 3E, 5E and the conventional approach of teaching on students' achievement in Biology. Their findings revealed that students who were taught Biology with 3E and 5E performed better than those taught with the conventional approach.

This confirms [2] who compared the 3E learning cycle approach of teaching to that traditional approach and found out that the experimental group which was instructed using the 3E learning cycle approach performed better on the posttest than the control group which was instructed with the traditional method

This study will investigate the effect of learning cycle approach of teaching on the academic performance of high achievers and low achievers at senior high schools. It will also find out the specific effect of the 3E, 5E, and 7E learning model on the academic achievement and retention scores of students in senior schools.

Objectives of the Study

The purpose of this study was to examine the effect of learning cycle approaches on selected concepts in integrated science in integrated science. The study will specifically:

1. Find out if there is a significant difference in the mean achievements and retention scores among students instructed on selected concepts in Integrated Science through 3E, 5E and 7E learning model.
2. Find out the effect of 3E learning cycle approach on the mean achievement and retention of selected concepts in integrated science.

3. Find out the effect of 5E learning cycle approach on the mean achievements and retention of selected concepts in integrated science.
4. Find out the effect of 7E learning cycle approach on the mean achievements and retention of selected concepts in integrated science.
5. Find out if there is significant difference between the post-test scores of low achievers and high achievers when instructed with 3E learning cycle approach.
6. Find out if there is significant difference between the post-test scores of low achievers and high achievers when instructed with 5E learning cycle approach.
7. Find out if there is significant difference between the post-test scores of low achievers and high achievers when instructed with 7E learning cycle approach.

Research Questions

1. What is the significant difference in the mean achievements and retention scores among students instructed on selected concepts in Integrated Science through 3E, 5E and 7E learning cycle approach?
2. What is the effect of 3E learning cycle approach on the mean achievement and retention score of selected concepts in integrated science?
3. What is the effect of 5E learning cycle approach on the mean achievements and retention score of selected concepts in integrated science?
4. What is the effect of 7E learning cycle approach on the mean achievement and retention scores of selected concepts in integrated science?
5. Is there any significant difference between the post-test scores of low achievers and high achievers when instructed with 3E learning cycle approach on selected concepts in integrated science?
6. Is there any significant difference between the post-test scores of low achievers and high achievers when instructed with 5E learning cycle approach on selected concepts in integrated science?
7. Is there any significant difference between the post-test scores of low achievers and high achievers when instructed with 7E learning cycle approach on selected concepts in integrated science?

Significance of the Study

It is hoped that the findings of this study will help integrated science teachers to know which of the learning cycle phase is appropriate for teaching the selected concepts in integrated science in Senior high schools.

It will also encourage the integrated science teachers to adopt inquiry-based learning cycle model to teach concepts in integrated science in Senior high school.

It will again make the school authorities encourage and motivate their teachers to use inquiry-based learning cycle model to teach integrated science in senior high school.

It will serve as evidence for the National Council for Curriculum and Assessment to propose for teachers to use inquiry-based learning cycle model for teaching integrated science in senior high school.

Delimitations of the Study

This study investigated the effect of learning cycle approaches of teaching on academic achievement and retention of selected concepts in integrated science in the Obuasi Municipality which is in the Ashanti Region of Ghana.

Specifically, the study focused on only SHS Two- Gold students because they were at school during the period of the study the other SHS students were on vacation.

The study covered the variable such as the effect of learning cycle approaches such as the 3E, 5 E and the 7 E on the academic achievement of students in some selected concepts in integrated science in senior high school.

The study covered four sub-topics in Magnetism, Rocks, Acid Base and Salt and Variation, Inheritance and Evolution. These topics were selected because the chief examiner keep reporting students' difficulty in them. Obuasi Municipality was selected for this study because the researcher has currently been posted to the area to teach. Therefore, the researcher will have enough time to visit these schools for the study.

Limitations of the Study

The major limitation to this study was the menace of Covid 19 pandemic. This reduces the effective interaction of students with their peers due to fear of contacting the disease through contacts.

Also, initially students resisted the inquiry process in which the teacher asks questions and the students explore and search for answers supporting it with evidence and communicating their findings.so rejected to their role as explorers. They were used to conventional method of teaching where the teacher only gives information and the students listen and take notes. The researcher.

Also, there was the need to train teachers in extensive professional development in inquiry-based learning cycle method of teaching but only two science teachers were willing to undergo such training.

Literature Review

The theoretical framework for this research study on the effect of the learning cycle approach on students' achievement in science is based on the constructivist theory of learning, which posits that students actively construct their own understanding of the world through a process of inquiry, exploration, and reflection [22]. The learning cycle approach, as proposed by [15] is a method of instruction that is grounded in constructivist principles and emphasizes hands-on, experiential learning through a sequence of stages that include concrete experience, reflective observation, abstract conceptualization, and active experimentation.

According to the constructivist theory, learning is a process of actively constructing knowledge through interactions with the environment and social interactions with others [28]. The learning cycle approach provides students with opportunities to engage in authentic scientific inquiry and experimentation, which can lead to deeper understanding and more meaningful learning experiences [11]. By following the stages of the learning cycle, students are able to build on their prior knowledge, make connections between new concepts and existing knowledge, and apply their understanding in real-world contexts.

Research has shown that the learning cycle approach can lead to improvements in students' understanding of scientific concepts, problem-solving skills, and overall academic achievement in science [18]. By engaging students in hands-on activities, encouraging them to ask questions, and providing opportunities for reflection and discussion, the learning cycle approach can foster a deeper conceptual understanding and help students develop critical thinking skills [4]. This study was grounded on 3E, 5E, 7E learning Cycle Models. Learning cycle is model which is student centered. It provides opportunities for students to develop confidence through active involvement of students during the learning process. In 1970, based on Jean Paget's cognitive development theory, Robert Karplus proposed a learning strategy in the form learning cycle. Even though this strategy was first used in elementary school, many studies have indicated that application of this teaching approach has been widespread at various levels of education, including universities [10] defined learning cycle as an arrangement of learning process in such a way from a series of activities and stages so that learning competencies are mastered by students through their active involvement in the whole series of

activities. This model uses a constructivist approach where knowledge is built on students own knowledge. Therefore, if the knowledge construction process occurs well then students understanding of the material learned will be improved and meaningful learning can be achieved.

Even though there are several constructivist teaching and approaches, the inquiry-based learning cycle approach has been found to mostly recommend by researchers to support students learning and academic achievement. [2].

Ref. [12] found out that inquiry -based method of teaching is very rewarding for both the male and female students and should not be limited to reading of text book but students should be allowed to investigate into problems in the society and provide solutions to these problems. Scientific knowledge must lead to solving societal problems. [10] opined that learning cycle is an inquiry-based teaching strategy and therefore seeks to promote learning through investigation and hands on activities. Many Science researchers in the science education field have tried to develop teaching approach which encourages learner-centeredness [20] opined that one of the best ways to use learner centered pedagogical approach in the classroom situations is by using learning cycles. This approach involves series of planed strategies used by the instructor during the teaching learning process. The learning cycles are based on mental development theory by Jean Piaget.

The learning cycle approach is a teaching method that aims to engage students in an active and participatory learning process by incorporating multiple stages of exploration, conceptual development, and application. This approach is often used in science education to help students develop a deeper understanding of scientific concepts and improve their critical thinking skills. In recent years, there has been increasing interest in examining the effectiveness of the learning cycle approach on students' achievement in science.

A study by [9] investigated the impact of the learning cycle approach on students' understanding of chemical bonding concepts. The researchers found that students who were taught using the learning cycle approach demonstrated significant improvements in their understanding of the concepts compared to students who were taught using traditional methods. The study also found that students who experienced the learning cycle approach were more engaged and motivated to learn.

Similarly, a meta-analysis by [2] examined the effects of the learning cycle approach on students' achievement in science across multiple studies. The meta-analysis found that the learning cycle approach had a positive impact on students' achievement, with effect sizes ranging from moderate to large. The researchers concluded that the learning cycle approach was an effective teaching strategy for improving students' understanding of scientific concepts.

Furthermore, a study by [2] investigated the impact of the learning cycle approach on students' understanding of energy concepts in middle school science. The researchers found that students who were taught using the learning cycle approach showed significantly higher gains in their understanding of energy concepts compared to students who were taught using traditional methods. The study also found that the learning cycle approach helped students develop a deeper conceptual understanding of energy and improved their ability to apply their knowledge to real-world situations.

This learning cycle has different phases. The first version has only 3 phase and this consist of exploration, concept development and expansion [5].

In the exploration phase the teacher allow the students to investigate into a given scientific concept that the teacher has initiated in the class. The learners are given enough opportunity to think freely and engage in peer

discussing within the concept given. The teacher provides the necessary tools, materials and equipment that will enable the learners to go through the exploration phase successfully. The students also collaborate with each other within their assigned group to gather the necessary data that will help them solve the problem given to them by the teacher. They also make necessary predictions and hypotheses based on the evidence collected. They record and interpret and organize their findings.

The teacher also encourages the learners to work together in a collaborative and cooperative manner. The teacher may also ask probing questions to redirect the students' investigations.

This phase stimulates students' curiosity, develops the need to know something [10]. Indicated that this phase offers opportunity for the learner to utilize their five senses as much as they interact with the environment through activities such as practicum, analyzing articles, observing and discussing natural phenomena. These activities should stimulate their high level of thinking as they begin to ask themselves questions as to how and why things occur in the way they are occurring. The emergence of such questions shows that students are ready for the next phase known as the concept development phase.

In the concept development (explanation), the learning process is supposed to lead to a balance between the concept the learner already knows and the concepts that have just been learned through activities that requires reasoning skills such as discussions [5]. Also, under this phase both the teacher and the learner have an active role to play. The learners are given the opportunity to verbalize their conceptual understanding. They are allowed to explain the underlying principles the scientific concepts given to them.

The teacher also encourages the students to explain the concepts in their own words and solicit for clarifications and justification from the students. The teacher also facilitates the discussions of the students' findings. The teacher then formally introduces the definitions and scientific terms in the topic. Ref. [5] opined that under this phase the students listen critically from their peer group explanations and can questions others explanations.

The next phase of the 3E learning cycle is the expansions phase where the students are allowed to extends and apply the concepts to new situations. Ref. [14] cautioned that teacher should be very carefully not to introduce unknown concepts to students at this stage.

The next learning cycle model is the 4E model which consists of four phases of instruction within the learning cycle. They are the Engagement, the exploration, the explanation and the evaluation.

At the engagement stage, the teacher generates the interest and stimulate the excitement of the students towards the concept. The teacher also finds out what the students already know and their misconceptions. Ref. [5] were of the view that this phase should be to encourage and motivate the learners to develop more in-depth desire to learn about the concept to be discussed. The students also do brainstorming to express their ideas to their peer groups. The exploration phase offers the students the opportunity to investigate into the scientific concepts. The students make some predictions base on the evidence collected. They collect and interpret data collected. Ref. [5] opined that at the explore phase the teacher can acts as consultant for the students. This phase aim at developing students understanding of the scientific principles underlying the concepts discussed.

The third phase of the 4E learning model is the explanation phase. In this phase the students are given the opportunity to demonstrate their conceptual understanding. The students explain the concepts in their own words and their teacher can ask for clarification and justification from the students.

The fourth phase of the 4E learning cycle is the evaluation phase. Under this phase the

teacher assesses students understanding of the concepts with formative and summative assessment. The students will also answer the questions asked by the teacher and may be ask to interpret data.

In the 5E learning cycle, there is a combination of the three phases in the 3E learning cycle and the addition of the latest two phases, they are engaging before exploring and evaluate at the end of the cycle.

The 5E learning model also consists of five phases within the learning cycle. These are the engagement, exploration, explanation, elaboration and evaluation.

In the engagement stage the prior knowledge of the students is review and link to new concepts through the use of short activities that promote curiosity. The teacher makes connections between past and presents learning experiences. Students are mentally engaged in the concept, process, or skills to be learned. The teacher also captures the students' interest and make them curious about the topic and concept to be learnt [5] stressed that this phase provides an opportunity for the teacher to find out what students already know and think about the topic or concept to be developed.

At the exploration phase the teacher involve the students in the topic providing them the opportunity to build their own knowledge through investigating and researching and manipulating of the materials. Student build a set of common experience as they work in groups and this prompt sharing and communicating. At this stage, the teacher acts as a facilitator guiding the students focus and the students actively learn through inquiry-based learning process.

The explanation phase focus students' attention on particular aspects of their engagement and exploration phase exploration experiences and provides students opportunity to demonstrate their findings, their conceptual understanding through discussion and presentations. It also provides the teacher the opportunity to introduce the concept, terms and explanations.

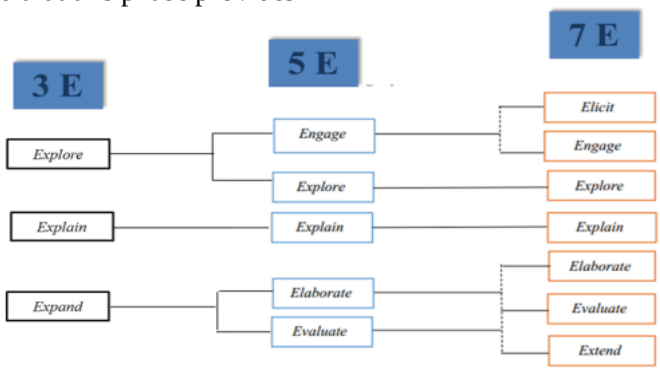

Figure1. Development of Learning Cycle by Arthur Eisenkraft [30].

The fourth phase of the 5E learning model is the elaboration phase after the discussions and explanations about the main ideas and scientific principles underlying the concepts it is important to involve the students in further experiences that extends the concepts and process to new situations. The students are encouraged to apply the concepts to new situations [14] stressed that the 'elaboration phase facilitates the transfer of concepts to closely related but new situations.

The last phase of the 5E learning model is the evaluation stage. The teacher gives the students opportunity to demonstrate their understanding of the concept. The teacher can administer both formative and summative assessment to determine each student understanding of the concepts [5].

The 7E learning model is a paradigm shift in the instructional approach [5]. It consists of 7 phases of instructions within the learning cycle. They are the elicitation, engagement,

exploration, explanation, elaboration, evaluation and extension.

The first phase of the 7E learning model is the elicitation stage. Under this phase the teacher draws students' attention to the prior knowledge and understanding of the concepts under study. The teacher tries to build new knowledge on the existing knowledge. The teacher may provide external stimulus in the form of concept cartoons, mind maps that will give them idea about the concept which will be study. The students try to connect given concept with their prior knowledge. At the engagement phase, the teacher focuses students thinking on the content by providing them the opportunity to talk to each other in their respective group. The teacher also generates and stimulate the interest of the learners towards the concept. The student also brainstorms during this stage [5] was of the view that they can use think-pair share technique to express their ideas to their peers.

The third phase of the 7E learning model is the exploration phase where students are given the opportunity to work together in a collaborative and cooperative manner. They make observations, design experiment, record data, organize data, make graph, and interpret among their peer groups.

At the explanation phase the students are given the opportunity to communicate their conceptual understanding and explain the concept with their own words. They listen to their peer group explanation and other group members explanations. This phase provide opportunity to introduce 'formal language, scientific terms and content information that might makes students prior experiences easier to describe' [21].

The next phase is the elaboration phase which has to do with the extensions of the learners' conceptual understanding. The teacher assists the students to think alternative explanation of the concept and the students use their prior knowledge to ask more questions, make decisions and draw reasonable conclusion from evidence. Students apply symbols, definition, concepts and skills to solve problem related to concept learned [11].

The 6^{th} phase of the 7E model is the evaluation phase. The teacher provide opportunity for students to assess and evaluate their own learning [22].

The evaluation can be in the form of formative or summative assessments, formal or informal assessment. The students can also be asked to complete a summary report during the evaluation phase.

The last phase of the 7E model is the extension phase. According to Sharma (2008) 'the aim of adding this phase is to inform the teacher that applying traditional assessment ways is not the last process.' It was to remind the science teacher the importance of transferability of the concept learned. The student practice transfer of learning by applying what they learned in the classroom to new situations. Students are also required to think, search, explain and find examples of the application of new concepts and skills that they have learnt.

Conceptual Framework

The conceptual framework for this research study on the effect of the learning cycle approach on students' achievement in science is based on the premise that the learning cycle approach, which incorporates hands-on, experiential learning and emphasizes inquiry-based instruction, has a positive impact on students' understanding of scientific concepts and their academic achievement in science. Drawing from the constructivist theory of learning [22, 28] the learning cycle approach is designed to engage students in active learning experiences that help them construct their own knowledge through experimentation, reflection, and application.

The learning cycle approach is built upon a framework of four key stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation

[15]. In the concrete experience stage, students engage in hands-on activities and experiments that allow them to directly interact with scientific phenomena. Through reflective observation, students reflect on their experiences, make connections between new information and prior knowledge, and identify patterns or relationships. In the abstract conceptualization stage, students develop theoretical understanding of the concepts through discussion, reading, and instruction. Finally, in the active experimentation stage, students apply their knowledge and skills in new contexts, test hypotheses, and further refine their understanding through practice.

Research has demonstrated that the learning cycle approach can facilitate deeper understanding of scientific concepts, enhance problem-solving skills, promote critical thinking, and improve overall academic achievement in science [11] [18]. By engaging students in active inquiry, providing opportunities for hands-on exploration, and encouraging reflection and discussion, the learning cycle approach promotes a deeper level of engagement and fosters a more meaningful learning experience for students.

In this research study, the conceptual framework will guide the design and implementation of the learning cycle approach in a middle school science classroom. The research will assess the impact of the learning cycle approach on students' achievement through pre- and post-tests, observations, and interviews. By examining the relationships between the key components of the learning cycle approach and students' academic outcomes, the study aims to provide insights into the mechanisms through which the learning cycle approach influences students' achievement in science.

Materials and Methods

The study employed a quasi-experimental non-randomized pre-test, post-test experimental group design. The study used a mixed method approach of both qualitative and quantitative method of data collection and analysis [6]. This approach was adopted because there was the need for the researcher to support the quantitative data with qualitative data for better understanding of how effective this teaching approach aid in teaching integrated science.

The quantitative part of this study was a quasi-experimental design a pretest-posttest

Non-equivalent group. This design was adopted because it was not possible to have complete randomization of subjects as this will disturb school organization. Quasi-experimental design is an empirical study used to estimate the causal impact of an intervention on its target population. Therefore, intact classes were randomly assigned to the experimental groups as 3E, 5E, and 7E.

The 3E experimental group were given treatment using 3E learning cycle approach, the 5E experiment group were also instructed with 5E learning cycle approach and 7E experiment group were also given instruction in 7E learning cycle approach. All the three groups however received the same test at the same time period.

A detailed lesson plan was prepared to ensure active involvement of students in the learning process. A pre-test was given to all the students in the three groups in order to measure their prior knowledge before the start of the instruction. A post-test was also given to the students 3 days after instruction in order to measure the effectiveness of the teaching approaches employed.

The qualitative data was obtained through the use of interviews where views of the students were solicited to ascertain the effectiveness of the approached used for instruction in the various experimental group. The use of the interview also helped to obtain in- depth information on how students perceived the learning cycle approach**.**

Some students from all the three groups were selected to interview after the instruction

including the three research assistants who did the instruction.

Population

Population is defined as the entire aggregation of cases that meet a designated set of criteria. It comprises the entire aggregation of elements in which the researcher is interested. They are the target group about which the researcher is interested in obtaining information and drawing conclusion from.

The target population for this study was all the Form 2 Senior High School students in the Obuasi municipality numbering 1200. The accessible population was the Form 2 Gold track students. This because the other Green-track students were not at school during data collection period. The accessible population were obtained from the following schools, Christ the King Catholic Senior High School, Obuasi Secondary Technical Senior High School and Sam Boachie Senior High School. Christ the King and Obuasi Secondary Technical Senior High School are public Senior high school while Sam Boachie Senior High school is private own school.

Sample and Sampling Techniques

Sampling refers to the process of selecting a portion of the population to represent the entire population. It enables the researcher to study a relatively small number of units in place of the target population. A multi-stage sampling techniques was used to select the schools and classes to be used for the study. Three schools were purposively selected from the total number of schools in the municipality. Purposive sampling was used to select these schools because these schools have a well - structured facilities as well as well trained teachers [6] opined that purposive sampling is employed because of special characteristic of the sample facilitating the purpose of the study. Simple random sampling technique was use to select 3E, 5E and 7E intact classes for the study. The 3 intact classes were selected from general Arts class in the three schools selected. 40 students were selected randomly from each of the three classes for the study. This is because according to [8] it ensures that all key characteristics of individuals in the population are included in the same proportion and it increases the likelihood of the sample being a true representation of the population. These classes were named 3E, 5E, 7E for easy identification.

In all a sample size of 120 was employed to carry out the study. This sample size was sufficient enough for this study because according to [8] for experimental and causal comparative studies, we recommend a minimum of 30 individuals per group'.

Table 1. The Distribution of the Sample by Schools and Forms

School	Class size	No. of Student Selected
OBUASI SEC TECH	500	40
CKC	250	40
SAM BOACHIE	200	40

Instruments

A test is a measuring instrument used to measure learners' knowledge, skills and aptitude. It may be administered orally, verbally, on paper or a computer in a predetermine area which requires the test taker to demonstrate his knowledge or skills.

In this study to ensure objectivity the integrated science multiple choice questions were adapted from West African Examination Council objective questions. The test items covered all the units that were taught during the interventional period. The test consists of two sections that is section I and section II. The

section I contain multiple choice questions and answers.

The section II also consist of the essay type questions in which students were to provide short answers to them. A marking scheme was prepared before administering the test to the students.

The use SAT is to assess students' achievement and retention on what they have been taught. To ensure validity, SAT was developed based on the table of specification.

The Semi-Structured Interview

The researcher prepared a semi-structured interview guide to collect data for the study. It was design to collect data from all the three experimental group selected. 5 students from each group were conveniently selected for the interview. This was to help the researcher to know how the participants were impressed about the method the teacher used and their understanding and performance so far in the concept taught. Semi-interview guide was used because the researcher wanted to gather descriptive data on the respondent own words as to how they feel about the method used to teach the concepts by the research assistant. The interview guide had 10 questions with some having follow up questions. These questions sought to find out whether the inquiry-based method used has had impact on their understanding and achievement in the concept taught.

Structured Observation

Observation as a research instrument provide the researcher the opportunity to observe the participant in the natural settings. Observation as data collection instrument can be structured or unstructured. In this study a structured observation was undertaking. The following were observed during the instruction.

1. The interaction between students-students and the teacher-students47
2. The participation and contribution of students in the learning process
3. Behavior and attitude of students towards learning
4. How students ask questions and responds to questions asked by the teacher.
5. How motivated students were to learn the concept taught.

Validation of Instrument

The science achievement test (SAT) and the other instructional materials like the lesson notes, table of specification were face validated by two experts in science education in the department of science and Technology university of Cape Coast.

The experts were to check whether the answers to the questions were correct or not. Also, they were to check whether the lesson notes prepare for the lesson were appropriate and correct. Suggestions from the experts were used to review the instruments and the instructional materials. Items that were considered too difficult or simple were restructured, and those that were not relevant were eliminated based on the experts' advice.

Reliability of the Test Instrument

The science achievement test (SAT) was trial-test to ascertain its reliability coefficient by administering it randomly to a 40 selected SHS students who were not part of the study. Test pretest procedure was used in the administration of the instruments to the students. Three intact SHS two classes were randomly sampled as experimental. These were the 3E group, the 5E group and 7E group.

Three research assistants were employed and trained by the researcher to teach the instructional units. Each of the experimental group were taught using 3E, 5E, 7E, learning cycle approach respectively. The test items (SAT) were administered to the two group in the form of pre-test before the treatment to ascertain their entry behavior. After the teaching, the test was reshuffled and administered again to the group to obtain the stability of the instruments. The scores from the

post-test were compared with the pre-test to ascertain if there could be any correlation between the two scores from the test. A Pearson product moment correlation coefficient used to obtain the reliability which gave a coefficient of 0.92. According to Frankel and Wallen (2000), a reliability coefficient of alpha value 0.7 and above is considered suitable to make possible group predictions which are sufficiently accurate. Therefore, the pre-test results satisfy the minimum prescribed reliability coefficient.

Data Collection Procedure

The Science Achievement Test (SAT) was used for data collection. The instrument was administered during the study and the scores were obtained and analyzed.

Treatment Procedure

The study was conducted during the normal school lesson periods. This is because of the Covid 19 pandemic there was no other way to have access to the students apart from the normal lesson periods. The normal time table of the three schools were used. Before starting the actual treatment, the researcher used four days to train the three integrated science teachers who assisted the study. The following areas were covered in the orientation for the three research assistants.

1. The purpose of the study
2. The integrated science concepts to be taught and how it will be taught
3. The procedure for the administration of the instrument
4. The 3E, 5E, 7E learning cycle approaches

This orientation program was to ensure homogeneity of instruction among the groups and the only difference was that each of the experimental group received instruction through different phases of the learning cycle approaches, thus the 3E, 5E, and 7E.

Intact classes were assigned to all the experimental groups after which the Science Achievement Test (SAT) was administered as pre-test. This took one week before the actual teaching began. During the treatment period, each of the experimental group 3E, 5E and 7E were taught some selected topics in integrated science using the 3E, 5E, 7E, learning cycle approach respectively. The actual teaching took four weeks to cover all the selected concepts.

The researcher prepared the lesson notes for the 8 weeks activities. The topics were selected from the areas the chief examiner has repeatedly reported that students have difficulties in them. The topics which were covered in the interventional process were rocks, acid bases and salt, magnetism and variations, hereditary and inheritance. A sub-topic was picked from each topic for the study. The participants of the study were put into eight groups of 30 with each group receiving instructions twice per week.

Three different lesson plans namely 3E lesson plan, 5E lesson plan and 7E lesson plan were prepared on the selected topics for the study. These lesson plans were used to instruct 3E, 5E and 7E group respectively.

The lesson plan was developed to ensure active involvement of students in the learning process. The activities in the lesson plan were implemented by considering the stages of 3E, 5E and 7E learning cycle model. In the engagement stage the teacher tried to increase students' attention make them become interested in the lesson and also ready to learn. The teacher ensured that students get the opportunity to make some connections between previous knowledge and present learning experiences.

In the exploration stage the teacher gave the students the chance to explore the topic and also gave the materials to the students to observe, record their observations, discuss their findings and interpret their findings. The teacher only went round to guide, provide feedback to students as they work in their respective groups.

The students were given the opportunity to demonstrate and presents their findings in the explanation stage. The teacher guided the students on how to make coherent and

consistent make generalization in the presentation. In the elaboration stage the students were given the opportunity to discuss how they can apply their knowledge in new situations. In the final stage which is the evaluation stage, the teacher then provided the students with activities which were used for both formative and summative assessment. This stage aided the researcher to make inferences and conclusions about the method employed and its effects on students understanding.

After the treatment the pre-test were reshuffled and administered as post-test to both groups. The post-test was marked by the research assistants with the marking scheme prepared by the researcher. The researcher then allowed a gap of four weeks and reshuffled the post-test and re-administered it again to ascertain if the knowledge gain was retained. This was to measure the retention of concepts learned during the intervention period. The retention test was scored analyzed.

In determine the low achievers and the high achievers, the researcher set a bench mark for the student. The bench mark was 50. Those students who score below the 50mark set were regarded as low achievers and vice versa.

Results

The data collected for the study was analyzed and interpreted based on the research questions formulated. Table 3-5 presents the results on the research questions.

Table 2. Mean Achievements and Std. Deviation of Pre-test and Post- test Scores among Students Instructed on Selected Concepts in Science through 3E, 5E and 7E Learning Model

class	N	Pre-test Mean	Std.	Post-test Mean	Std Deviation	Mean gain
3E	40	10.68	1.54	14.97	2.41	4.29
5E	40	10.78	1.33	24.52	2.03	13.47
7E	40	10.77	1.36	23.88	1.6	13.11

Table 2 above shows the mean achievement and standard deviation of pre-test and post-test scores among students instructed on selected concepts in science through 3E, 5E and 7E learning model. The pre-test means scores for 3E, 5E and 7E were 10.68, 10.78 and 10.77 respectively with their standard deviation 1.54, 1.33 and 1.36 respectively. This means that 5E learning model class had the highest score in the pre-test with mean difference of 0.01 which is very insignificant. This indicates that 3E, 5E and 7E class were almost at the same level of achievement before the intervention. The post-test means scores however differ for the various class. The post-test means scores for the 3E, 5E, 7E class were 14.97, 24.52 and 23.88 respectively. The standard deviations scores for the three group were 2.41, 2.03, and 1.6 respectively.

Table 3. Mean Retention and Std. Deviation Scores among Students Instructed on Selected Concepts in Integrated Science through 3E, 5E and 7E Learning Model

class	N	Pre-test Mean	Std.	Post-test Mean	Std deviation	Mean gain
3E	40	10.68	1.54	14.33	1.76	10.68
5E	40	10.78	1.33	24.43	1.96	13.38
7E	40	10.77	1.36	21.16	1.69	10.39

Source: Field Survey (2021)

Table 3 above shows the mean achievement and standard deviation of pre-test and retention test scores among students instructed on selected concepts in integrated science through 3E, 5E and 7E learning model. The pre-test means scores for 3E, 5E and 7E were 10.68, 11.05 and 10.77 respectively with their standard deviation 1.54, 1.60 and 1.36 respectively. This means that 5E learning model class had the highest score in the retention test with mean difference. This indicates that 3E, 5E and 7E class were almost at the same level of achievement before the intervention. The retention means scores however differ for the various class. The retention means scores for the 3E, 5E, 7E class were 14.35, 24.43 and 21.16 respectively. The standard deviations scores for the three group were 1.76, 1.96, and 1.69 respectively. Thus, the 5E model class showed more achievement than the other two model classes after the interventions.

To assess the significant difference in the mean achievements and retention scores among students instructed on selected concepts in Integrated Science through 3E, 5E and 7E learning model, the one-way between-groups Analysis of Variance (ANOVA) was conducted to determine the significant difference in the mean achievements and retention scores among students instructed on selected concepts in Integrated Science through 3E, 5E and 7E learning model.

Table 4. ANOVA Results of Mean Achievement and Retention Scores

		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Pre-test	Between Groups	.800	2	.400	.200	.819
	Within Groups	233.525	117	1.996		
	Total	234.325	119			
Post-test	Between Groups	2277.800	2	1138.900	**273.434**	**.000**
	Within Groups	487.325	117	4.165		
	Total	2765.125	119			
Retention	Between Groups	2782.717	2	1391.358	**424.731**	**.000**
	Within Groups	383.275	117	3.276		
	Total	3165.992	119			

A one-way between-groups analysis of variance was conducted to explore the difference in the mean achievements and retention scores among students instructed on selected concepts in Integrated Science through 3E, 5E and 7E learning model. Participants were divided into three groups (Group 1: 3E; Group 2: 5E; Group 3: 7E). Thus, for the pre-test results, there was no statistically significant difference at the $p > 0.05$ level in the pre-test scores for the three groups: $F (2, 117) = 0.20$, $p = 0.819$. Despite not reaching statistical significance, the actual difference in mean scores between the groups was quite small. The effect size, calculated using eta squared, was 0.003. Post-hoc comparisons using the Tukey HSD test indicated that the there was no significant difference in the mean score for all the three groups after the pre-test.

In addition, results for the post-test scores revealed that there was a statistically significant difference at the $p < 0.05$ level of significance

in the post-test scores for the three groups: F (2, 117) = 273.434, p = 0.000. The actual difference in mean scores between the groups was large. The effect size, calculated using eta squared, was 0.82. Post-hoc comparisons using the Tukey HSD test indicated that the mean score for the 3E group (M = 14.97, SD = 1.54) was significantly different from the 5E group (M = 24.52, SD = 2.03) as well as the 7E group (M = 23.88, SD = 1.6). Also, there was a significant difference between the 5E group and the 7E group.

Furthermore, the retention test results after the intervention showed that there was a statistically significant difference at the $p < 0.05$ level of significance in the intervention test scores for the three groups: F (2, 117) = 424.731, p = 0.000. The actual difference in mean scores between the groups was large. The effect size, calculated using eta squared, was 0.88. Post-hoc comparisons using the Tukey HSD test indicated that the mean score after the retention test for the 3E group (M = 14.97, SD = 1.54) was significantly different from the 5E group (M = 24.52, SD = 2.03) as well as the 7E group (M = 23.88, SD = 1.6). However, the 5E group and the 7E group did not differ from each other.

Table 5. Shows the Effect of the Learning Cycle (3E, 5E, 7E) Approaches on the Mean Achievement and Retention Score of Selected Concepts in Integrated Science, the One-way Repeated Measures ANOVA was used

Model	Hypothesis df	Error df	Wilks' Lambda	F	p-value	Partial Eta Squared
3E	2	38	0.185	83.59	0.00	0.815
5E	2	38	0.025	739.50	0.00	0.975
7E	2	38	0.018	1051.99	0.00	0.982

Source: Field Survey (2021)

A one-way repeated measures ANOVA was conducted to compare scores on the students' achievement Test during the pre-test, post-test, and the retention tests. The means and standard deviations are presented in Table 1. For the students taught with the 3E learning cycle approach model, there was a significant effect of the 3E model, Wilks' Lambda = 0.185, F (2, 38) = 83.59, $p < 0.05$, multivariate partial eta squared (0.815) showed a very large effect of the 3E model on the students' mean achievement and retention scores (Cohen, 1988). Additionally, the results of the 5E model used to instruct students in the 5E class revealed that there was a significant effect of the 5E learning cycle approach, Wilks' Lambda = 0.025, F (2, 38) = 739.50, $p < 0.05$, multivariate partial eta squared (0.975) showed a very large effect of the 5E model on the students' mean achievement and retention scores. Finally, the results of using the 7E learning cycle approach to teach the students in the 7E model group revealed a significant effect of the 7E learning cycle approach, Wilks' Lambda = 0.018, F (2, 38) = 1051.99, $p < 0.05$, multivariate partial eta squared (0.982) showed a very large effect of the 7E model on the students' mean achievement and retention scores.

Is there any significant difference between the post-test scores of low achievers and high achievers when instructed with 3E, 5E, and 7E learning cycle approaches on selected concepts in integrated science?

The independent sample t-test was used to determine whether there was a statistically significant difference between the post-test scores of low achievers and high achievers when instructed with 3E, 5E, and 7E learning cycle approaches on selected concepts in integrated science. The results are shown in Table 5.

Table 6. T-test Statistics of Low Achievers and High Achievers Post Test Scores

Sex of teachers	N	Mean	Std. Deviation	df	t-value	p-value
3E Learning Cycle Approach						
Low Achievers	22	15.18	2.68	38	0.59	0.56
High Achievers	18	14.72	2.08			
5E Learning Cycle Approach						
Low Achievers	23	24.09	2.09	38	-1.62	0.11
High Achievers	17	25.12	1.83			
7E Learning Cycle Approach						
Low Achievers	24	24.13	1.45	38	1.21	0.23
High Achievers	16	23.50	1.79			

Source: Field Survey (2021)

An independent-samples t-test was conducted to compare the performances of low achieving students and high achieving students thought using the various 3E, 5E, and 7E learning models. For the students instructed using the 3E model, the results of their posts test showed that there was no significant difference in scores for low achievers (M = 15.18, SD = 2.68) and high achievers (M = 14.72, SD = 2.08; t (40) = 0.59, p = 0.56, two-tailed). The magnitude of the differences in the means (mean difference = 0.46, 95% CI: –1.45 to 2.09) was very small (eta squared = 0.009). Furthermore, analysis of the results obtained from the post-tests of the students instructed using the 5E model showed that there was no significant difference in scores for low achievers (M = 24.09, SD = 2.09) and high achievers (M = 25.12, SD = 1.83; t (40) = -1.62, p = 0.11, two-tailed). The magnitude of the differences in the means (mean difference = 1.03, 95% CI: –1.11 to 2.03) was moderate (eta squared = 0.06). Finally, the post-test result of the students instructed with the 7E learning cycle approached revealed that there was no significant difference in scores for low achievers (M = 24.13, SD = 1.45) and high achievers (M = 23.50, SD = 1.79; t (40) = 1.21, p = 0.23, two-tailed). The magnitude of the differences in the means (mean difference = 0.63, 95% CI: –2.32 to 0.25) was very small (eta squared = 0.04).

Discussion of Findings

The descriptive analysis of the data collected from the test results showed that the 5E learning model class had the highest score in the pre-test, post tense, and retention tests conducted. However, the ANOVA results revealed that there was no statistically significant difference in the pre-test scores for the three groups showing that there are no significant variations in pre-test results of the 3E, 5E, and the 7E model classes. This means that the entry behavior of the students before the study was conducted were equal. However, the post-test scores showed a significant difference between the results of the 3E, 5E, and the 7E model classes with the actual mean difference in the results measured by the eta-squared revealing a large effect. This means that the intervention of the model classes had significant effects on the students' understanding of the selected topics.

Thus, there was a significant difference between the achievements of the 3E model class and the 5E model class as well as the 7E model class and a difference between the achievement of the 5E model class and the 7E model class. This result may be explained by the active participation of students at every stage of the instructional models. This therefore means that the difference between the test scores of the class model groups was due to result of the intervention. This, thus, agrees with the finding of Vygotsky (1978) that

learning is facilitated by social interaction with more sophisticated individuals that provide guidance during the learning process.

When the students were left for some time before the retention test was conducted, it was expected that there would be variations in the achievements of the students. Thus, the results showed that there was a statistically significant difference in the achievement of the students. This may not be necessarily due to the intervention since the students might have consulted their learning resources and materials to get more insight into the selected topics. That notwithstanding, the results showed that the effects of the intervention on the students' achievement in the retention test was very large with the 3E model group performing significantly than the 5E and the 7E model groups with no significant difference in the achievement of the 5E and the 7E model groups. The results of this study agree with the assertion made by Ngalimun (2014) that when learning cycles are arranged in such a way to form series of activities and stages, learning competences are mastered by students.

Furthermore, the study sought to determine the effect of the learning cycle (3E, 5E, 7E) approaches on the mean achievement and retention score of selected concepts in integrated science. Using the one-way repeated measures ANOVA, it was found that there was a significant and very large effect of the 3E, 5E, and 7E models on the students taught with the 3E, 5E, and the 7E learning cycle approaches. Hence, the models used for the intervention have had significant impacts in the achievement of the students with the 7E model having the largest impact on the students' mean achievements and retention. Thus, from the works of Vygotsky (1978), it can be deduced that guidance provided by science teachers during instruction may have influenced the conceptual understanding of the students, which resulted in their better achievements. This also agrees with the findings of Hiccan (2008) who examined the influence of 5E learning cycle approach on students' achievement in linear equations in one variable and found that in the 5E learning cycle group, the pre- and pro-test achievement scores were significantly different.

Finally, to determine whether there was any significant difference between the post-test scores of low achievers and high achievers when instructed with 3E, 5E, and 7E learning cycle approaches on selected concepts in integrated science, it was found that there was no significant difference in scores for low achievers and high achievers taught with the 3E, 5E, and 7E model. Thus, the 3E, 5E, and 7E models used for the intervention has no significance difference on the academic achievement of low achieving students and high achieving students. This means that the low achieving and high achieving students exhibited same level of understanding after the models were used to teach them resulting in almost the same performance when they were assessed after the models were utilized to determine the effect of the model on their achievements.

This was evident in the 3E and the 7E models resulting in a very small effect in the achievement of the low achievers and the high achievers with the 5E model having a moderate impact in the achievement of the low achievers and the high achievers after the post-tests. This means that the students in the learning cycle classrooms benefited in about the same margin irrespective of their level of achievement before the intervention. The results may be explained with the fact that the use of the learning cycles in the teaching of the concepts made the understanding and internalization of the concepts taught easier, especially for the low achieving students, which made them became par in their performances in the post-test with the high achieving students. Thus, [9] stated that in the activities based on the learning cycle sequence, as demonstrated in this study, the teacher created interest and curiosity to draw the students' attention and excite them, in the

phase of engagement; provided opportunities for students to make them discover the topic and create a situation of need-to-know setting the phase for the explanation phase.

Conclusion

Based on the findings of the study, the following conclusions were made:

1. At the pre-test stage, all the model class groups showed the same level of understanding in the concepts whilst during the post-test and retention stage, the learning cycle approaches had a significant influence on the students' achievements hence the differences between the 3E model class and the 5E model class as well as the 7E model class whereas there was no difference in the achievement of the 5E and the 7E model class after the retention test.
2. The models used for the intervention have had significant impacts in the achievement of the students with the 5E model having the largest impact on the students' mean achievements and retention.

The 3E, 5E, and 7E models used for the intervention have no influence on the academic achievement of low achieving students and high achieving students. This means that the low achieving and high achieving students exhibited same level of understanding after the models were used to teach them resulting in almost the same performance when they were assessed after the models were utilized to determine the effect of the model on their achievements.

Recommendations

The following recommendations were made based on the findings of the study:

Science teachers should adopt the use of the learning cycle approaches to teach science concepts to the students to arouse the students' interest in the subject since the use of learning approaches have the tendency to increase the achievement of students.

Suggestions for Further Research

Further studies is needed into learning cycle which could help science teachers to understtand what influences students conceptual change in learning cycle class, the influence of learning cycle on students' attitude towards science, and teachers' sex differentials and use of learning cycle as an instructional method. Further studies can also be conducted to unravel the significance difference between male and female students' achievement using learning cycle approache

Acknowledgements

I would like to express my deepest gratitude to all those who have supported me throughout the course of my study.

First and foremost, I am grateful to Allah for the wisdom He has given me. I am also grateful to my research supervisors for their guidance, patience, and expertise in helping me navigate the complexities of the research process.

I am also thankful to my colleagues and peers who have provided valuable feedback and insights that have greatly enriched my work.

Additionally, I would like to acknowledge the support of my family and friends who have stood by me and encouraged me every step of the way.

Finally, I am grateful to the participants in my study who generously shared their time and experiences, without whom this research would not have been possible.

Thank you to all who have contributed to this project in any way, big or small. Your support and encouragement mean the world to me.

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